Ohio Agricultural Experiment Station.

BULLETIN 103.

WOOSTER, OHIO, MARCH, 1899.

THE SAN JOSE SCALE PROBLEM IN OHIO IN 1898.

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BULLETIN

OF THE

Ohio Agricultural Experiment Station.

NUMBER 103. MARCH, 1899.

THE SAN JOSÉ SCALE PROBLEM IN OHIO IN 1898.

BY F. M. WEBSTER.

In this bulletin it has been the author's intention to give the actual status of the problem of the San José scale in Ohio at the beginning of the year 1899. A glance at the map, illustrated in Fig. 1, will show the increasing number of outbreaks that are being located. In a number of cases, the pest has spread out widely from where it was known to occur in 1897. Occasionally, an individual is found who is willing to state that this pest will soon be overcome by its natural enemies; that while it is a serious pest and one that should be fought, it is not so bad as the codlin moth, etc. The last five years in Ohio, as well as in most of the other states east of the Mississippi, have demonstrated that these statements are incorrect, and that the orchardist and nurseryman have more to fear from this pest than from any other known to this country, at the present time. The fact that state after state is falling into line and appropriating money to control and destroy the pest is sufficient evidence to show that the people are finally waking up to the necessity of prompt and efficient action.

Ohio nurserymen must furnish a certificate of inspection in order to ship their stock into other states, but nurserymen outside of Ohio, with uninspected stock, are naturally looking to this State as one of those into which they can lawfully ship such stock, thus making Ohio a dumping ground, as it were, for anything that cannot be marketed elsewhere.

VARIOUS MEASURES FOR EXTERMINATION AND REPRESSION.

Nearly if not quite all of the at present known practical measures for the suppression of the San José scale in the eastern United States may be collected under five groups, as follows: —

1. Burning.
2. Whale oil soap.
3. Application of kerosene in some form.
4. Fumigation.
5. Utilizing natural enemies.

BURNING.

While this measure is sometimes the most expensive, it is the only one that is absolutely effectual under all conditions. Besides, it is not infrequently the cheapest in the long run. When we come to count the cost in time and material of saving a tree that has passed its prime, or is of a variety that is not of the best, or when a very young tree, only recently set, is found to be badly infested, it will be cheaper to clear everything up and burn, thus at once settling the whole problem. I think it will pay to try to save trees not seriously affected, if such are of desirable varieties and have nearly reached the bearing age or have not yet reached their best; but the treatment must never be left to the private individual. It must be the business of some person who has official authority to see that the work of treating is done properly and at the proper time, else it will as a rule amount to nothing. While I believe this pest *can* be controlled by the application of repressive insecticides, experience has shown that in nine cases out of ten this *will not* be done.

THE USE OF WHALE OIL SOAP.

The value of this preparation in fighting the San José Scale has been demonstrated by myself and other investigators; the chief objection to its use being the disastrous effect on the fruit buds of the peach, if applied during fall or winter. It has also been learned that, if applied in spring, at time of blooming, the peach buds are not materially injured.

The most serious outbreak of San José scale in Ohio was located on Catawba Island, along the shore of Lake Erie, in the midst of the peach growing region of the State. In the spring of 1897 a large amount of whale oil soap was used with good results, and where the application was made in spring and no freezes followed, no material injury was noticed. There was also a little Peach leaf curl, *Exoascus deformans,* and there seemed to have been a check in this disease where the whale oil soap had been applied. However, as there was very little of the disease present, and few peaches, it was not thought best to make any statements as to the effect of treatment with the whale oil soap.

The spring of 1898 brought entirely different conditions, both as to fruit and disease, and the effect of treatment with the whale oil soap has been simply astounding. We had really a monster experiment, carried on, not by one person, but by some 15 or 20, and covering an area of some 300 acres. Where the application of the soap had been made during winter, the effect was to destroy the peach buds; but where treatment

had been carried out just as the buds were on the point of putting forth, even a mixture of two pounds of soap to one gallon of water had no detrimental effects on the fruit buds, while it to all appearances afforded a complete protection from the attacks of the leaf curl, which has this season been the most severe in many years. Even where but one pound of whale oil soap was used to one gallon of water, the effect appears to have been as decisive on the leaf curl as where double the amount of soap was used, while three-fourths of a pound to a gallon of water was nearly as effective.

In going over these orchards on August 11, the difference between the treated and untreated trees could be readily seen at a glance. The Smocks and Salways were not attacked by the leaf curl, and were now carrying a full crop of peaches, while all other varieties, where the trees were not treated in spring, had scarcely any fruit at all, yet the treated trees of the same varieties, in the same orchard and in many cases in the same row, had from 75 to 100 per cent more fruit than the untreated trees. A careful, conservative estimate, made by those competent to do so, indicated that there was an average of 75 per cent more peaches on the treated trees than there was on the untreated, and that the difference in size in favor of the treated trees would amount to fully 50 per cent and the growth of tree and amount of foliage to 35 per cent. Growers claim, and with apparent reason, that the treatment with whale oil soap for San José scale has given them an average of $1.00 per tree profit, the soap costing them about four cents per pound, laid down.

We do not yet know the minimum strength of whale oil soap mixture that will suffice to prevent this leaf curl. The peach grower must himself find out this, as well as the relative value of the application as compared with Bordeaux mixture, price of material and cost of applying considered, and it would not only be an unwarranted assumption on my part to attempt to champion either measure, thus anticipating the outcome, but it would be compromising both myself and the institution with which I am connected to do so.

With regard to the effect of these applications of the whale oil soap on the San José scale, while it has not yet been exterminated, it has been greatly reduced, so much so, in fact, that the owners of infested orchards have now little fear but that they will be able to entirely eradicate it within the next two or three years. Heretofore, it has sometimes been difficult to get the owners of some slightly infested orchards to apply whale oil soap, but this season has taught them a lesson that they will not soon forget, for while they stubbornly refused to treat their orchards last spring, they now had the rather humiliating spectacle of trees on their own premises, almost, if not quite totally devoid of fruit, while their more progressive neighbors, who invested their money in whale oil soap and applied it faithfully, have plenty of fruit, and no longer fear the San José scale. Many orchards whose owners could hardly have been induced to treat their trees last season, on suspicion of the San José scale

being present, will hereafter treat on the slightest possible suspicion of its presence, and do it willingly. On Catawba Island, at least, the beneficial effects of the application of whale oil soap, as against the leaf curl, has solved the San José scale problem in a manner wholly unlooked for. Where a year ago owners of orchards were badly discouraged over the prospect of getting rid of the scale, they now have no fears of not being able to do so, and they expect to derive a profit in the meantime from the beneficial effects, as against insects other than the scale, and the practically total prevention of leaf curl in their orchards. Surely it is an ill wind that does not do somebody good. For my own part, I have never felt so encouraged over the prospect of overcoming the San José scale, in this locality, as at the present time, *if* the fight so well begun shall only be universally continued.

THE USE OF DILUTED KEROSENE.

This can be used for summer treatment, for destroying the young, but we have not seen any indication that it would be at all effective as against the full grown scale during the winter season.

THE USE OF PURE KEROSENE.

Attention was first called to the application of pure kerosene, to fruit trees, for the purpose of destroying the San José scale, by a paper presented by myself at the Buffalo Meeting of the Association of Economic Entomologists, and published in Bulletin No. 6, N. S., U. S. Dept. Agr., Div. Entomology, pp. 69-70, and also in Bulletin No. 81, Ohio Agr. Exp. Station. This paper related only to applications made during winter while the trees were in a dormant condition. So far, no injury has come from such application to apple and the more hardy varieties of pear, cherry and plum, if the application was not overdone and too much kerosene applied.

During March, 1897, a series of experiments were made with pure kerosene applied to several varieties of fruit trees. From the results of this series of experiments we have learned, among other things, that the ill effects of kerosene on trees may or may not become apparent immediately after the application. In some cases trees that seemed to have been uninjured died later, while others that had clearly suffered slightly, afterwards recovered. (See Table I). These applications were made with equal care, and far more cautiously than would be likely to be done by the average farmer or fruit grower.

It must not be forgotten that there are two factors involved in these experiments, viz.: to destroy the scale, and not to injure the trees. There is little trouble in doing either one, separately, but to accomplish both ends at the same time is far less easy than may at first appear. An over-fine spray is not likely to reach all the scales, while too much kero-

TABLE I.—EXPERIMENTS WITH PURE KEROSENE APPLIED TO FRUIT TREES, MARCH, 1897.

Kind of Tree.	Variety of Fruit.	Pruned.	Un-pruned.	Grade of Oil.*	Method of Application.	Temperature.	Condition of Tree June 28, 1897.	Condition of Tree July 28, 1898.
Pear	Domingo		X	Water white	Brushed	34°–38° F.	Injured.	Alive, fruiting, no scale.
"	Seneca		X	Elaine	Sprayed	40°–45° F.	Dead	
"	Vermont Beauty		X	"	"	"	Uninjured	Dead.
"	Lincoln		X	"		"	"	Dead.
Apple	Canada Red	X		Water white	Brushed	34°–38° F.	"	Healthy.
"	"		X	"	Sprayed	40°–45° F.	Slight injury.	"
"	Paradise winter Sweet	X		Elaine	Brushed	34°–38° F.	Uninjured	"
"	"		X	"	Sprayed	40°–45° F.	Slight injury.	"
"	(?)	X		Eocene	Brushed	34°–38° F.	Uninjured	"
"	"		X	"	Sprayed	40°–45° F.	Dead	Leafed sparingly and later died.
Peach	Crosby	X		"	Brushed	34°–38° F.	"	Only 80 buds started May 14th, 1897.
"	"		X	"	Sprayed	40°–45° F.	"	Only 36 buds started May 14th, 1897.
"	"	X		Water white	Brushed	34°–38° F.	"	Not a single bud started May 14, 1897.
"	"		X	"	Sprayed	40°–45° F.	Badly injured.	Recovered.
"	"	X		Elaine	Brushed	34°–38° F.	"	
"	"		X	"	Sprayed	40°–45° F.	Dead	
Plum	Brunswick	X		Water white	Brushed	34°–38° F.	Uninjured	Dead.
"	Burbank	X		Eocene	"	"	"	Dead.
"	Wild Goose	X		Elaine	"	"	"	Dead.
"	Lombard	X		Water white	"	"	"	Healthy.
"	"		X	"	Sprayed	40°–45° F.	Slight injury.	Dead.
Cherry	Reine Hortense		X	Elaine	"	"	Dead	
"	Napoleon		X	Eocene	"	"	Nearly dead.	Dead.

*These grades run about 120 degrees flash test, as that grade complies with the Ohio laws and they seldom run much above the requirements.

Compare with table on page 201, Bulletin 81, of this Station.

sene will reach all, but will kill the tree. Spraying theoretically, on paper, is one thing, while practical spraying in the orchard is quite another.

On September 14, 1897, with the temperature ranging from 85 to 90 degrees Fah., with the sun shining brightly, a second series of experiments was undertaken by my assistant, Mr. C. W. Mally, using undiluted kerosene as before. All of the applications in this series were made with a spray pump; the work was done with the greatest of care and the finest spray that it was possible to secure was thrown over the trees, but in no case was there sufficient kerosene used to run down the trunks of the trees or drip from the foliage.

It may be stated here that it is not possible to use such an exceedingly fine spray, lightly, under the above conditions without treating some portions of the tree twice, and possibly small areas not at all, as the kerosene evaporates so quickly, that in a few minutes it is impossible to tell the sprayed from the unsprayed surface, or to determine just where, in going around the tree, the work was begun. In short, there is a vast difference between spraying on paper and spraying in the orchard, and in all of our experiments we have utterly failed to hit upon a perfectly safe method of applying undiluted kerosene to orchard trees, except to those of the most hardy varieties, and beyond these we find the danger of injury to the trees far too great to warrant an unqualified recommendation for its general use, no matter how carefully the applications are made. Trees sprayed after sunset were more injured than those treated during the afternoon, in bright sunshine and under a higher temperature. But some of the check trees were even in a worse condition on May. 18, 1898. In any case, within a short time after spraying the foliage took on a dull appearance, contrasting with the brighter, healthy green of the surrounding untreated trees.

The results of this series of experiments are given herewith in tabulated form. (See Table II.)

All sprayed trees dropped their foliage prematurely, especially the peach, which was nearly denuded of leaves, while others were yet in nearly full leaf, while such of the peach leaves as remained were located at the tips of the inner branches, thus indicating that they had escaped treatment with the kerosene.

The maple put out leaves, and up to May 9, 1898, appeared uninjured, but died later.

On May 9, 1898, three peach trees were carefully sprayed with undiluted kerosene, the bloom having just fallen, the temperature being about 90 degrees Fah., with bright sunshine. By July 18, 1898, all were dead. Of five apple trees sprayed under the same conditions as the peach trees, both as to time, temperature and material, four were apparently injured and one dead on July 28, 1898. It does not seem to me necessary to discuss the matter further.

Despite all that has recently been said or written, then, we have yet much to learn in regard to this pest and the best methods of controlling

TABLE II — EXPERIMENTS WITH PURE KEROSENE APPLIED TO FRUIT TREES, SEPTEMBER, 1897.

Kind of tree.	Temperature.	Condition July 28, 1898.
Plum	85° to 90° F.	Tree had been dead since May 18, 1898.
"	" "	" " " November, 1897.
"	" "	" " " May 18, 1898.
"	" "	" " " May 18, 1898.
Cherry	" "	" " " May 18, 1898.
Pear (2 trees)	" "	Trees healthy.
Pear (1 tree)	" "	Tree healthy May 9, 1898. Live scale Apr. 12, 1898.
Same tree	90° (about)	Resprayed May 9, 1898. Dead July 28, 1898.
Peach	100° (about)	Tree dead on May 18, 1898.
Apple (in nurs. row)	90° (about)	Trees healthy with a few exceptions.
" "	" "	Sprayed after sunset. Little injury.
Hickory	" "	Tree healthy.
Sassafras	" "	Tree dead May 18, 1898.
Dogwood	" "	Tree healthy.
Maple	" "	Tree healthy May 18, 1898. Dead.
Hawthorne	" "	Tree apparently slightly injured.
Walnut	" "	Tree dead except one branch. Shooting up from roots.
Ash	" "	Tree perfectly healthy.
Wild cherry	" "	Tree dead. Shooting up from roots.
Oak	" "	Tree injured.
Elm	" "	Tree injured.

and overcoming it in orchard and nursery. Besides, the problem of its management is one which justly deserves the best efforts of economic entomologists of America, especially as we are being at present closely followed by our Australian cousins, and mistakes or premature statements will thus not only affect the interests of our people, but those of other and far distant countries as well. While every effort should thus be made to prevent mistakes and indefinite statements, based on insufficient data, yet as we gain point after point and are secure in our advance, we owe it to the people of this and other countries to place our knowledge thus gained where it can be utilized.

PRESENT KNOWN OUTBREAKS IN OHIO.

When the map accompanying bulletin 81, of the Experiment Station was engraved, in June, 1897, there were 22 localities indicated thereon where it was known that the pest had been more or less thoroughly established. We now have a record of 28 additional localities of infection, making in all 50 outbreaks within Ohio. (Five additional cases have since been discovered).

NURSERY INSPECTION.

Some of the outbreaks in Ohio are being effectually managed, the one on Catawba Island being in an especially encouraging condition, but in the majority of cases the outlook is less satisfactory. I wish to here repeat what I have stated again and again, viz.: that the public cannot reasonably expect that our nurserymen will be able to keep their premises

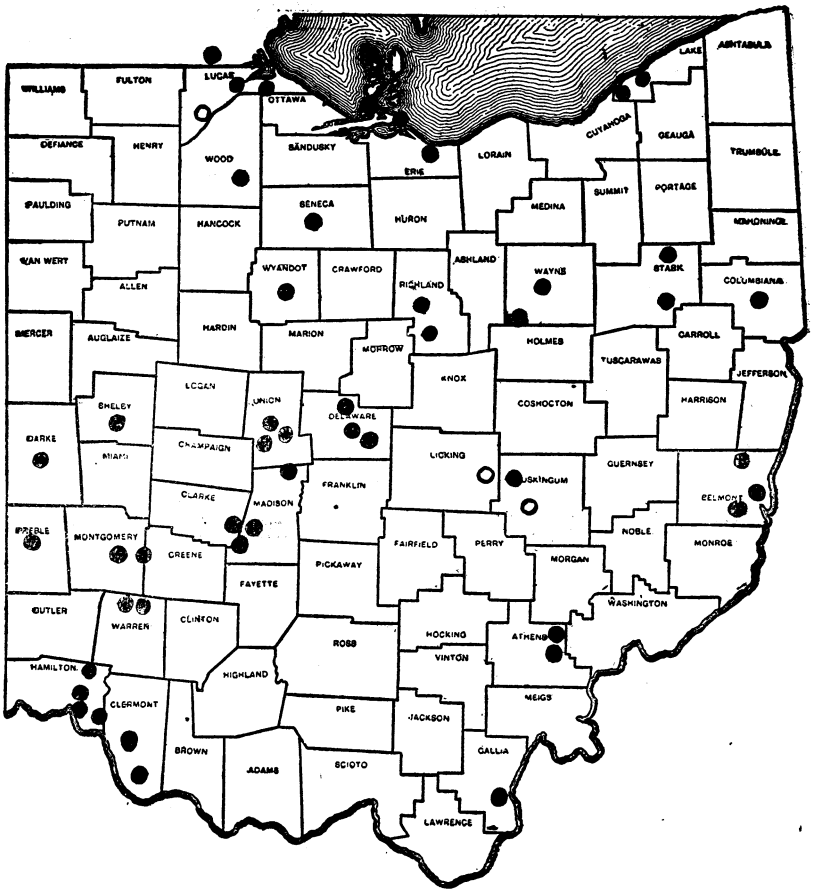

Fig. 1. Map showing location of known outbreaks of Jose' Scale in Ohio, March 1, 1899. O indicates exterminated outbreaks.

clear of this pest, unless the country about their nurseries within a radius of several miles, is also kept above suspicion. Unfortunately, the only law now on our statute books is absolutely worthless, so far as its effect in compelling the suppression of this pest, or any other, for that matter, is concerned, unless the majority are entirely in favor of doing so. The nurserymen are, unfortunately in the minority, with, of all others, the most at stake. If matters continue, as they have been going during the last year, some other arrangements will have to be made for nursery inspection, as it will soon come to be too dangerous a matter for me to decide whether a nursery is infested or not, with the time that, in my present capacity, I can possibly give to its examination. It will be too dangerous, not only for myself, but for the nurseryman also, as he cannot build a Chinese wall about his grounds or fence out the birds, and we have ample proof that the latter may infect a nursery from an infested orchard located

several miles away, and in such a manner as to elude the eye of the most careful inspector, unless he is to go over every tree with a lens, a labor that is not possible in my case.

FUMIGATION OF NURSERY STOCK.

Whale oil soap applications will probably not, as a general thing, prove as profitable for the nurseryman as for the fruit grower. For them fumigation with hydro-cyanic acid gas is by far the cheapest and most practical remedy or preventive against the San José scale, and, if I mistake not, this will come more and more into practical use, and within a few years, fumigation will be practiced by all nurserymen. I believe that it is the most effectual measure that can be applied to nursery stock, not only as against the San José scale, but all other insect pests that are likely to infest it, externally. The expense of fumigation, after a suitable building or compartment is fitted up for the purpose, is a mere trifle. Large growers can use a packing house or store house, by making these air tight and trees can can be loaded on the wagons in the fields, driven to the packing or store house, run inside, and, within an hour's time have them fumigated and ready to heel in or place in car, as the case may be. Wagon loads can be brought in at noon and fumigated during the noon time, and the trees be ready to handle by the time the men are ready to go to work in the afternoon, or the wagons can be loaded and brought in at night, the fumigating done, the house aired out, and everything made ready for disposal the following morning. These estimates allow 45 minutes for fumigation, and 15 minutes for airing out the house before entering. If the stock is packed in a house or compartment it will be necessary to wait a longer time for the room to air out, before it will be safe to enter, but it will be best not to keep stock longer under influence of the gas than the time given.

THE FUMIGATING HOUSE.

Now, in regard to the fumigating house, as it has come to be called, we have been studying the matter at the Station with the aid of Mr. Owen's experience while acting as a special assistant in my department, and I believe we have simplified the matter considerably, and also rendered the use of the gas much safer and more agreeable, for you must understand that this gas is a deadly poison, as effective on humans as on insects, and even though not enough of the fumes are inhaled to seriously injure those who are using, yet it will show its effect in headache and other ways.

In the first place, the apartment intended for fumigating must be as near air tight as it is possible to get it, in order to hold the fumes, which, as they are colorless, like smokeless powder, give no optical indication of either presence or escape. For this reason, if a new building is constructed, it should consist of two thicknesses of boards, the inner or outer matched, and between these a lining of building paper, the edges of which

overlap and do not break joints at corners or under the eaves. Ceiling will be influenced less by wet, of course, if within, and if placed outside, should be kept well painted. In fact, in this case the grooves should be partly filled with paint, as the matched sheeting is laid on. Then, care must be taken to have no cracks about the bases of the rafters, the paper being secured about these with glue. The doors should shut tightly against some sort of felt or rubber padding, and may be double or single, according to the desire of the owner. There should be a ventilator in the roof, so arranged that it can be opened and closed from without. We have found a slat floor, raised 8 inches or a foot from the ground, preferable to using the ground itself for the floor, though where it is intended to drive wagons into the house, this will answer all purposes. With a slat floor, the gas is generated beneath, and almost instantly spreads throughout the entire space between the ground and floor, passes upward through the trees, and we thus promptly reach every part of the apartment at almost the same time. (See Fig. 3.)

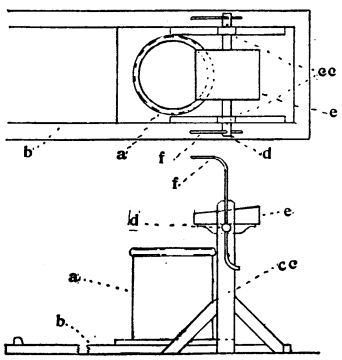

Fig. 2.

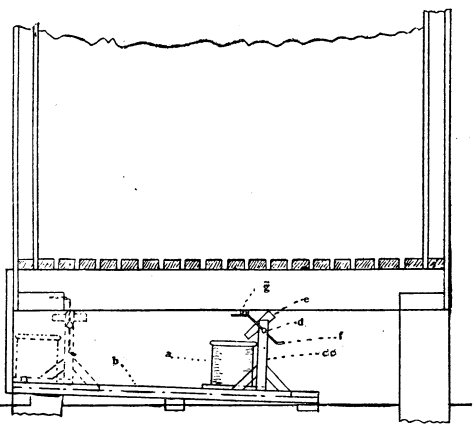

Fig. 3.

The generator (See Fig. 2) consists of an earthen jar of the requisite capacity (a), fixed to the end of a plank (b), and just in front and between two posts (cc), through which passes a roller (d), and to this last is fixed a pan (e), with back and sides, but no front, one end of the roller projecting beyond the post with a small iron bar or heavy wire (f) passing through it, and being fixed and bent at either end, the whole having much the appearance of a windlass, with the pan (e), added. The sulphuric acid and water are placed in the jar, and the potassium cyanide in the pan above, and the plank is pushed down a slight incline (Fig. 3), over which a cleat (g), is fastened, which catches the wire or rod (f), and thus dumps the pan (e), throwing the contents into the jar (a), thereby completing the mixture and generating the gas; and as a drop door closes as soon as the plank is pushed down the incline, there is no chance of the

operator breathing the fumes. The whole arrangement is simple, and anyone at all handy with tools can easily construct the whole apparatus from materials found about almost any nurseryman's premises.

HYDROCYANIC ACID GAS.

Hydrocyanic acid gas is made by first placing sulphuric acid in water and then adding potassium cyanide. For each 125 cubic feet of space contained in a fumigating house, 1 fluid ounce of sulphuric acid is used in 2 fluid ounces of water, with 1 ounce of fused cyanide of potassium, 98 per cent. pure, and stock should be submitted to the fumes of this gas for 45 minutes, and, if the trees are packed in the house, at least 30 minutes should elapse after the doors and ventilator are opened before any attempt is made to remove the stock.

RESULTS OF FUMIGATING NURSERY STOCK.

From some experiments carried out by Mr. W. H. Owen, under general instructions from myself, while he was engaged as a temporary assistant, together with some observations made by me, in Maryland, on stock fumigated under the supervision of Prof. W. G. Johnson, I have been strongly impressed with the efficiency of the gas treatment. If fumigation is carried out faithfully and accurately, in a properly constructed compartment, I would rather have a certificate of fumigation than my own certificate of inspection. It is a physical impossibility for me or any one else to look at every tree in a nursery, and if this were possible, there might be a few scales ensconsed under bits of bark or down behind buds, (See Fig. 4) where no eye could possibly detect them, yet the fumes of this gas will reach them and kill them. Of course, if the San José scale gets into a nursery, it will be detected before it has become very widely distributed or excessively abundant, as annual inspections are carried out, but the pest can be carried in by birds or on scions, and totally escape the eye of the most careful and conscientious inspector, but they cannot escape the fumes of hydrocyanic acid gas, if properly applied. Mr. Owen was never able to get scale through this fumigating process alive, though he placed badly infested stock in the most secluded and protected places in the room. Young trees with living scale on them have been covered thickly with mud, or placed in the room as wet as they could be made, yet the effect has been precisely the same.

If this fumigation is superintended by an efficient person, the stock thus treated will be far safer than much that is being handled by dealers to which misused certificates are attached.

We have in one case sent a temporary assistant, at the expense of the owners of the nursery, who after he has thrown out all stock that has any appearance of being infested by the San José scale, sees the remainder passed through the fumigation process, and afterwards attaches his statement of what has been done, to each package of stock. This shows the

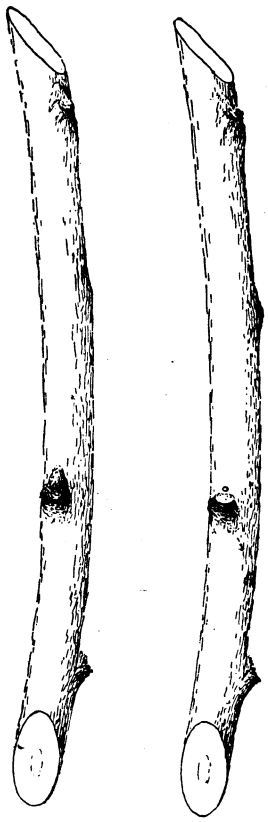

Fig. 4. Showing, at left, twig with bud covering scale, and same twig at right with bud removed, showing scale in position. Original.

good intent of the proprietors and protects them from undue discrimination. It seems to pay them to do this and it protects the people.

TRACING THE SAN JOSE SCALE TO JAPAN AS ITS NATIVE HOME.

On April 29th, 1898, the writer found the San José scale, *A. perniciosus,* with the Peach scale, *Diaspis amygdali,* on Japan white semi-double Flowering Cherry, received direct from Japan during the winter of 1896-7, the trees having been planted out in an isolated locality during the latter part of April, 1897, and though having been growing in America for nearly or quite a year, their location was sufficient proof that they could not, by any possible chance, have become infested in this country. Only a part of the trees were infested, and these but slightly, the scale being more abundant near the surface of the ground and diminishing in numbers upward, while there were none to be found on the branches. The trees were small, being only about a half inch in diameter at base.

A lot of stock, belonging to the same varieties as those above mentioned, *Prunus pandula* and *P. pseudo-ceraceus,* that had also been im-

ported directly from Japan and from the same firm, but during the winter of 1897-8, was then examined. Unlike the first lot, these trees had never been removed from the storehouse where they had been unpacked from the boxes in which they were imported. These trees were smaller than the others, having evidently been arch grafted, on older stock of some variety of cherry, by cutting off the original top and leaving a stump about six or eight inches in height and an inch or more in diameter, the cleft for the insertion of the graft being made after the usual manner, but instead of using a scion in the ordinary way, a young growing shoot of the flowering cherry had been inserted into the cleft at one side of the stump at the top, and the juncture covered with grafting wax, the shoot however, not being severed until after it had united with the stump, when it was cut off just below the juncture, thus greatly facilitating the growth of the graft, as it could draw its nourishment from the parent stock until it had firmly united with the new. These old stocks or stumps were much more seriously infested with the San José scale than the younger wood, averaging from one to six individuals to the square inch of bark surface, but extending upwards on the young growth well toward the extremity. On the old wood many of the scales were dead, but there were plenty of live ones and it was impossible to determine whether or not the dead had been parasitized, partly eaten by carnivorous enemies, or crushed in the handling of the stock, but that this was a direct importation does not admit of a doubt.

In *Entomological News,* Vol. IX., pp. 95-96, Mr. T. D. A. Cockerell states that Mr. Alexander Craw, quarantine officer at San Francisco, California, had "two or three times" found *Aspidiotus perniciosus* on trees from Japan, and, notably, on a plum tree that arrived January 25th, 1898.

In the Agricultural Gazette of New South Wales, Volume 9, Part 11, November 1898, page 1282-85, Mr. Walter W. Froggatt, Government Entomologist, gives additional proof of the introduction of San José scale from Japan as follows: —

"There is not the least doubt that, in a number of cases, we are indebted to California for the introduction of this pest; yet we have undoubted proof that it has been received in this Colony direct from Japan upon ornamental shrubs and fruit-trees. About five years ago a large consignment of Japanese plum-trees was imported direct from Japan by a firm laying out an orchard in the Gosford district. I examined the trees this winter, and found about one-third dead, another third very badly infested, and the remainder more or less infested. I was fortunate enough to find the man who unpacked and planted most of these trees, and not only did he assure me that they came direct to the estate from the ship, but that when he opened them out he noticed some scale unknown to him upon several of the trees.

"Again, while visiting an inland town, a local nurseryman asked me to examine a small lot of weeping cherries and other plants which he had obtained from Japan, and which were still in the pots in which they had arrived. They were stunted, with very thick, rough stocks, to which they had been grafted, and were covered with San José scale on the tips of the twigs. On looking up

his dates I found that this package had passed through the Customs only the month before the Vegetation Disease Act came into force in New South Wales.

"Again, one of the nurserymen, whose firm is credited with first bringing this pest into the Colony, says that he is certain that, in the first instance, it came into their nursery upon Japanese plum stocks from Japan and not from California."

NATIVE NATURAL ENEMIES.

During the past summer I have introduced the Florida fungus enemy, *Sphaerostilbe coccophila* in Ohio, and placed it in four different localities where the San José scale occurs, but there is yet no indication that the fungus has spread from the sections of wood on which it was brought from Florida. The little black Lady Beetle, *Pentilia misella,* has been observed in greater abundance and over a wider area of the State than ever before, but here again, I cannot see that it is holding the San José scale in check, and for this reason help from natural sources does not appear to be immediately at hand.

THE IMPORTATION OF NATURAL ENEMIES FROM JAPAN.

Mr. Cockerell thinks that the San José scale may probably be a native of the more or less elevated regions of Japan, the species of scale insects found there near the sea level seeming to belong to oriental tropical types. It was impossible to learn the exact locality where the stock examined by me had been propagated, but there were certainly no indications of immunity to the attack of this scale, though the trees might, perhaps, have withstood the attack better and survived longer; but, judging from all that could be observed from the actions of the scale on the importation of 1896-7, without the influences of natural enemies, it would spread as rapidly on a tree from Japan as it would on one from America, and this raises the question as to why, if it occurs in Japan, as it certainly does, this scale does not become as destructive there as with us in America. If this immunity is not due to resistive powers of the stock, and I certainly believe, from what I saw in these cases, it is not, then the protection must come from the influences of natural enemies, which is of itself the best possible proof that Japan is the native home of *Aspidiotus perniciosus,* and that we have a case parallel with that of the introduction of the Cottony-cushion scale, *Icerya purchasi,* into California from Australia. We have imported the San José scale and left behind its natural enemies that hold it in check in Japan, and while we cannot tell just what these enemies are, if the scale is a native of that country we have probably been importing it for years, and in that case, if the enemies were of a fungous nature, or internal feeders, we should have gotten them with their host insect long ago. It seems probable, then, that these enemies, or at least the one that is holding this scale in check, is one that is easily separated from its food and has for this reason been left behind in the importation of fruit and ornamental stock upon which the scale has occurred. The overwhelming success that followed the introduction of the Australian lady beetle, *No-*

vius cardinalis, and the suppression of the Cottony-cushion scale might not again be repeated in the case of the San José scale, as, in case of a successful introduction of its natural enemies, its wide diffusion over the country would render its suppression much more difficult, but it would now seem that we have in our possession information enough to indicate very strongly that in Japan *Aspidiotus perniciosus* has natural enemies, which, if brought to this country and distributed in infested orchards and places where the scale exists, would sooner or later overcome this pest and hold it in check thereafter. We have accomplished this once and saved from ruin an immense industry, starting with even less prospects of success than we now have in the case of the San José scale. A competent entomologist located in Japan, for perhaps a year, would solve the problem, as within that time he would be able to study the San José scale and its enemies over a considerable area of country, and if such enemies were transmittible, and we have no reason to suppose that they are not, arrangements could be made to have them transported in quantity to the various Experiment Stations in this country in the States where the scale is known to occur. From a scientific standpoint, there does not appear to be a single significant obstacle in the way of again carrying out this plan of introducing from a foreign country the natural enemies of an insect that has been introduced with the plants upon which it depredates, while these natural enemies, owing to their habits, have been left behind.

Financially speaking, there ought to be no question as to the value to the country of the benefits to be derived from this importation, in case it is found to be practical. Even if it should fail, which must be reckoned among the possibilities, but not by any means among the probabilities, the financial loss would be but a mere bagatelle for either Canada or the United States, or even a single State, for that matter.

The total expense of sending Mr. Koebele and myself to Australia (See reports U. S. Commissioners to Centennial Exhibition at Melbourne, 1888, p. 78) in 1888-89, exclusive of salaries, was exactly $1,694.97. Besides, I was charged with other duties in Australia and could do but little actual entomological work. With $2,000 or $2,500 at his disposal, an entomologist would be able to accomplish all that I have indicated, provided, of course, that he was already a salaried officer and his pay was continued by the institution with which he was connected. There are two widely separated townships in Ohio, in either one of which the San José scale has done injuries that would amount to the larger of these sums, if not even more.

NOTE: The matter included in this Bulletin, has, some of it, been presented at the meeting of the Society for Promotion of Agricultural Science, at Boston, Mass., in August, 1898, and at the Ohio State Horticultural Society at its December, 1898, meeting, and will be found among the proceedings of these bodies for that year. A short paper, published in the Canadian Entomologist for July, 1898, on "The Importation of the San José Scale from Japan" has also been used herein.

PUBLICATIONS

OF THE

OHIO AGRICULTURAL EXPERIMENT STATION.

A complete list of previous publications of this Station may be found in Bulletin 95. Following are the titles of subsequent bulletins:

No. 96. The Army Worm and other insects; Wheat and Grass Sawflies; the Corn or Boll Worm; the Painted Hickory Borer; the Raspberry Cane Borer; the Peach Scale.

No. 97. Diseases of wheat and oats.

No. 98. Small fruits; cultural notes and comparison of varieties.

No. 99. Sugar beet investigations in 1898.

No. 100. A comparison of factory-mixed and home-mixed fertilizers.

No. 101. Experiments with oats.

No. 102. Soil and seed treatment and spray calendar for insect pests and plant diseases.

No. 103. The San José Scale in Ohio.

No. 104. Further studies upon spraying peach trees and upon diseases of the peach.

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